PCT / IB 03 / 03717

19.08.03

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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

02292122.5

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R C van Dijk

Anmeldung Nr:
Application no.: 02292122.5
Demande no:

Anmeldetag:
Date of filing: 28.08.02
Date de dépôt:

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If no title is shown please refer to the description.
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Track jump unit.

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s) revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

G11B7/00

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR

Track jump unit.

FIELD OF THE INVENTION

The present invention relates to a track jump unit for performing jumps of a light beam of an optical pickup device from a given track to another track of a disc.

The present invention also relates to a method for performing jumps of a light beam of an optical pickup device from a given track to another track of a disc.

The present invention is particularly relevant for an optical disc apparatus for reading and/or recording data from and/or to an optical disc, e.g. a CD or DVD player and/or recorder.

BACKGROUND OF THE INVENTION

A conventional optical disc apparatus, for reading data recorded on a disc and/or for recording data on a disc is illustrated in Fig.1.

Fig.1 is a block diagram showing an overall structure of an optical disc apparatus. The optical disc apparatus comprises an optical pickup device 101 which can send and receive a light beam 102 to and from a disc 100. The optical disc apparatus further comprises an actuator 103 which can displace the optical pickup device 101 when provided with a displacing signal DS. A processor 104 processes a light beam reflected from the disc in order to read data from the disc or controls a light beam sent to the disc in order to write data on the disc.

The disc 100 comprises tracks on which the data to be read are written. When data are read from the disc, the light beam 102 has to stay in the middle of a given track. When the processor 104 detects that the light beam 102 is not in the middle of the given track, a displacing signal DS is sent to the actuator 103, which displaces the optical pickup device 101 in order to hold the light beam 102 in the middle of the given track. This operation is referred as "tracking". Based on the light beam reflected from the disc, a tracking control loop is able to hold the light beam 102 in the middle of a given track.

The actuator 103 can also be used in order to perform small jumps from a given track to another track located a few tracks away from the given track. This operation is referred as "jumping". A jumping control loop is used to provide the displacing signal DS in order to displace the actuator 103, so that the light beam is displaced from a given track to a desired track. When a jumping operation is performed, the actuator 103 is first moved with a predefined velocity over the

tracks. Based on the reflected light beam, a counter counts the number of tracks crossed by the light beam. By monitoring the number of tracks crossed in a fixed time interval, a speed measure is achieved. Then, knowing the number of tracks crossed by second, the actuator is moved during the right time in order to reach the desired track.

However, such a jumping operation can be performed only if accurate speed measurements are available. As a consequence, this jumping operation can not be performed for jumping a small number of tracks, because accurate speed measurements become available only after the crossing of several tracks. Therefore, if one wants to perform a jump of a small number of tracks, e.g. 5 tracks, such a jumping operation leads to an inaccurate placement of the light beam.

Furthermore, as two different control loops are used for tracking and jumping, transient phenomena can appear when switching from a tracking operation to a jumping operation. During these transient phenomena, the light beam can move in a wrong direction. This leads to an inaccurate placement of the light beam and to a long time required to perform a jump.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a track jump unit which is capable of accurately performing jumps of a few tracks, in which the problems described above are eliminated.

According to the invention, there is provided a track jump unit for performing jumps of a light beam of an optical pickup device from a first track to a second track of a disc, said unit comprising:

- displacing means for displacing the light beam, said displacing means being controlled by a displacing signal;
- reflected light beam detecting means for detecting a light beam reflected from the disc when said disc is supplied with a light beam coming from the optical pickup device, and for producing a reflected light beam signal;
- radial error detecting means for producing a radial error signal when said radial error detecting means are supplied with at least one reflected light beam signal, said radial error signal comprising at least a portion corresponding to the first track;
- counting means for associating at least a current track identifier to the first track;
- extended radial error computing means for computing an extended radial error signal when supplied with the radial error signal, said extended radial error signal being a monotonous signal based on at least a portion of the radial error signal and comprising portions having track identifiers associated thereof;
- generating means for generating the displacing signal, said generating means being controlled by the extended radial error signal and a current track identifier, a

jump from the first track to the second track being performed by modifying the current track identifier.

According to the invention, the displacing signal controlling the displacing means is generated on the basis of an extended radial error signal and a track identifier. The extended radial error signal is derived from the reflected light beam and can therefore be computed during tracking. Therefore, only one control loop can be used for tracking and jumping. This eliminates the transient phenomena.

Furthermore, as a jump is performed by modifying a track identifier, no speed measurement is required. This track jump unit can thus be used to perform small jumps, e.g. from one track to a directly adjacent track.

In a preferred embodiment, a jump from a given track to a desired track is performed by jumping from one track to a directly adjacent track until reaching the desired track, a jump from a track under consideration being performed by modifying a current track identifier.

According to this preferred embodiment, only a small numbers of identifiers are required.

The present invention also relates to a method for performing jumps, said method being carried out by a track jump unit such as described hereinbefore.

The present invention also relates to a computer program comprising a set of instructions which, when loaded into a processor or a computer, causes the processor or the computer to carry out this method.

These and other aspects of the invention will be apparent from and will be elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example, with reference to the accompanying drawings, in which:

- Fig. 1 shows an overall structure of an optical disc apparatus according to the background art;
- Fig. 2 is a block diagram illustrating a track jump unit according to the invention;
- Fig. 3 illustrates a disc structure and light beams used to detect a radial error signal by the track jump unit of Fig.2
- Fig. 4 illustrates signals detected by the track jump unit of Fig.2;
- Fig. 5 illustrates an extended radial error signal derived from the radial error signal of Fig.4;
- Fig. 6 illustrates track identifiers;

- Fig. 7 illustrates a jump of one track performed according to the invention;
- Fig. 8 illustrates a jump of a few tracks performed according to a preferred embodiment of the invention;

DETAILED DESCRIPTION OF THE INVENTION

A track jump unit according to the invention is depicted in Fig.2. Such a track jump unit comprises an optical pickup device 201, displacing means 202, reflected light beam detecting means 203, radial error detecting means 204, counting means 205, extended radial error computing means 206 and generating means 207.

A light beam 221 is sent to a disc 211. A reflected light beam is then detected by the reflected light beam detecting means 203, which produce a reflected light beam signal 231. Reflected light beam signals 231 are sent to the radial error detecting means 204, which produce a radial error signal 232, as it will be described in more details on Fig.3 and 4. When the light beam 221 is on a given track, the counting means 205 associate a current track identifier 234 to this given track.

Based on the radial error signal 232, the extended radial error computing means 206 compute an extended radial error signal 233, as it will be described in more details on Fig.5. The extended radial error signal 233 comprises portions having track identifiers associated thereof, as it will be described in more details on Fig.6. The extended radial error signal 233 and a current track identifier 234 are sent to the generating means 207 which generate a displacing signal 235 to control the position of the light beam 221, as it will be described in more details on Fig.7.

Fig.3a to 3c represent a disc structure and signals used to detect the radial error signal. A disc comprises tracks on which the data are written. For example, a track on a DVD might contain an image of a video and the DVD might contain 45000 tracks. A track comprises pits and lands, the pits being represented by rectangles on Fig.3, on which three tracks T1 to T3 have been represented.

When a light beam is on a pit, the reflected light beam signal is low, while it is high when the light beam is on a land. This property is used to write digital data on a disc and read these data from the disc, as explained hereinafter. When a light beam, e.g. a main light beam S of Fig.3, is on a track, e.g. T2, and the disc is in rotation, the main light beam S is on a pit, then on a land, then on a pit and so on. Therefore, the reflected light beam signal, which can be detected by photodiodes, varies. These variations are used to detect "1" and "0", which are

written on the disc. For example, a "1" can be detected when there is a transition between a pit and a land.

The property of pits and lands is also used in order to detect the radial error signal, which can be used for the tracking operation. To detect the radial error signal, two secondary light beams S1 and S2 are used, which are symmetrically disposed in relation to the main light beam S.

On Fig.3b, the main light beam S is on the track T2. The secondary light beams S1 and S2 are therefore off-track, and the reflected light beam signals corresponding to S1 and S2 are high and equal. The radial error signal is detected by computing the difference between the reflected light beam signals corresponding to S1 and S2, which is thus null when the main light beam is on-track.

On Fig.3a, the main light beam S is almost off-track, on the left of track T2, the first secondary light beam S1 is almost on-track and the second secondary signal S2 is off-track. The radial error signal is therefore negative.

On Fig.3c, the main light beam S is almost off-track, on the right of track T2, the first secondary light beam S1 is off-track and the second secondary signal S2 is almost on-track. The radial error signal is therefore positive.

During tracking, the radial error signal is used to send a displacing signal to the displacing means, in order to displace the main light beam S. When the radial error signal is null, the main light beam S is on-track and no displacing signal is sent to the displacing means. When the radial error signal is negative, a displacing signal is generated, in order to move the main light beam to the right, until the radial error signal is null. When the radial error signal is positive, a displacing signal is generated, in order to move the main light beam to the left, until the radial error signal is null. The displacing means can be, for example, the actuator 103 of Fig.1.

Fig 4 represents a disc cross section and signals detected by the track jump unit according to the invention. From the top to the bottom are represented a disc cross section, a central aperture signal CA, a radial error signal RE, a radial polarity signal RP and a track loss signal TL.

The central aperture signal CA is the alternative part of the reflected light beam signal corresponding to the main light beam S of Fig.3. When the main light beam is on-track, for example on track T1, T2 or T3, the central aperture signal CA is minimum, because a track comprises pits. When the main light beam is off-track, the central aperture signal CA is maximum, because an off-tack portion of the disc only comprises lands. A transition between off-track and on-track is characterized in that the central aperture signal crosses zero.

The radial error signal RE is maximum when the main light beam S is on a transition between an off-track portion and a track, null when the main light

beam S is in the middle of a track, minimum when the main light beam S is on a transition between a track and an off-track portion and null when the main light beam S is in the middle of an off-track portion.

The radial polarity signal RP is obtained by digitalizing the radial error signal RE and the track loss signal TL is obtained by digitalizing the central aperture signal CA.

Fig.5 illustrates how the extended radial error signal ERE is derived from the radial error signal RE. In this example, the track under consideration is the track T2, i.e. the main light beam S is on track T2.

The portion of the radial error signal RE corresponding to the track T2 is taken as a basis for the extended radial error signal ERE. Then the portion of the radial error signal RE corresponding to the off-track portion between the tracks T2 and T3 is inverted, and an offset corresponding to the amplitude of this inverted portion is added to the extended radial error signal ERE. Then an offset corresponding to the amplitude of the portion of the radial error signal RE corresponding to the track T3 is added to the extended radial error signal ERE. On the other side of track T2, the portion of the radial error signal RE corresponding to the off-track portion between the tracks T2 and T1 is inverted, and an offset corresponding to the amplitude of this inverted portion is added to the extended radial error signal ERE. Then an offset corresponding to the amplitude of the portion of the radial error signal RE corresponding to the track T1 is added to the extended radial error signal ERE. A monotonous signal is thus obtained, comprising the different portions of the radial error signal RE, eventually inverted and/or shifted.

In other words, the portions of the radial error signal RE, which are inverted and shifted in order to obtain the extended radial error signal ERE, are the portions of the radial error signal RE corresponding to the off-track portions of the disc. These off-track portions of the disc can easily be detected when the track loss signal TL is in his high state. The portions of the radial error signal RE, which are only shifted in order to obtain the extended radial error signal ERE, are the portions of the signal corresponding to the on-track potions. These on-track portions correspond to a track loss signal TL in his low state.

It is important to notice that the whole radial error signal RE might not be available. Actually, the radial error signal RE might be detected only for the track under consideration, i.e. the track T2 in the above-mentioned example. In this case, the extended radial error signal ERE might be computed as follows.

The portion of the radial error signal RE corresponding to the track T2 is taken as a basis for the extended radial error signal ERE. Then an offset corresponding to this portion is added to the extended radial error signal ERE, on

either sides of the extended radial error signal ERE, and so on. In other words, the extended radial error signal ERE is a monotonous signal comprising portions having amplitudes equal to the amplitude of the portion of the radial error signal RE corresponding to the track under consideration.

The advantage of using an extended radial error signal ERE is the following. When the radial error RE has the value x, the tracking control loop has no way to know if the main light beam S is on point A or on point B. The tracking is thus not reliable. For example, suppose there is an unwanted jump of the light beam from the middle of track T2 to the point A. If the radial error signal RE is used as an input of the tracking control loop, this loop might react as if the main light beam were on point B, and might generate a signal in order to displace the main light beam to the left until the radial error signal RE has the value zero. Then, the main light beam will be in the middle of track T1 instead of the middle of track T2.

However, if the extended radial error signal ERE is used as an input of the tracking control loop, the values of the extended radial error signal ERE are different when the main light beam is on point A or on point B. Suppose there is an unwanted jump of the light beam from the middle of track T2 to the point A. The extended radial error signal ERE has then a positive value y, and the tracking control loop generates a signal in order to displace the main light beam to the right until the extended radial error signal ERE has the value zero. If there is a shift of the main light beam from the middle of the track T2 to the point B, the extended radial error signal ERE has then a negative value z, and the tracking control loop generates a signal in order to displace the main light beam to the left until the extended radial error signal ERE has the value zero.

Fig.6 illustrates how track identifiers are associated to the portions of the extended radial error signal ERE. In this example, the track under consideration is the track T2, i.e. the main light beam S is on track T2. A current track identifier is associated to the track T2. In this example, this identifier is equal to 0. Then, when the light beam is displaced radially to the right, the identifiers are incremented each time the track loss signal TL presents a transition from a high state to a low state or vice versa. When the light beam is displaced radially to the left, the identifiers are decremented each time the track loss signal TL presents such a transition. Therefore, the identifier associated to the track T2 is 0, the identifier associated to the track T1, or to the portion of the extended radial error signal ERE corresponding to track T1, is −2 and the identifier associated to the track T3 is 2.

In the case where only the portion of the radial error signal RE corresponding to the track under consideration is detected, the tracks identifiers

might be determined as follows. When an offset is added on one side of the radial error signal RE corresponding to the track under consideration, in order to compute the extended radial error signal ERE, the identifier is incremented. When an offset is added on the other side of the radial error signal RE corresponding to the track under consideration, the identifier is decremented.

Fig.7 illustrates how a jump is performed according to the invention. A current track identifier and the extended radial error signal ERE are sent to the generating means. The current track identifier indicates which portion of the extended radial error signal ERE is to be used by the generating means. For example, if the current track identifier is equal to 0, the portion of the extended radial error signal ERE to be used by the generating means for tracking is the portion crossing the value 0.

Suppose the light beam is on track T2 and one wants to perform a jump from track T2 to track T3. Such a jump is performed by modifying the value of the current identifier sent to the generating means. Actually, suppose the value -2 is sent to the generating means instead of the identifier 0. Then the portion to be used by the generating means is the portion crossing the value x1, i.e. the portion corresponding to the track T1. Therefore, the value of the extended radial error signal ERE becomes x1. The generating means thus generate a signal in order to displace the light beam to the right until the extended radial error signal ERE has the value 0, hence bringing the current identifier back to 0. But as the light beam was in fact in the middle M2 of track T2 and not in the middle M1 of track T1, such a displacement brings the light beam in the middle M3 of track T3. Therefore, a jump from track T2 to track T3 is performed.

If a jump from track T2 to track T1 has to be performed, the identifier 2 is sent to the generating means instead of the current identifier 0.

An example of a jump from one track to a directly adjacent track has been described. It is important to notice that longer jumps might be performed according to the invention. For example, if a jump from track T2 to a track located two tracks away from track T2, on the right of track T2, is to be performed, the identifier -4 is sent to the generating means instead of the current identifier 0.

Fig.8 illustrates a jump according to a preferred embodiment of the invention.

At step 801, a jump is initiated from the current track to a track located on the right N tracks away from the current track, N being an integer, e.g. N=10. At step 802, the identifier sent to the generating means is modified, and the value –2 is sent to this generating means. As it has been described on Fig.7, this

leads to a jump from the current track to the directly adjacent track located on the right, and this brings the identifier back to 0. A counter is incremented in parallel at step 803. When the one-track jump has been performed, i.e. when the identifier has been brought back to 0 at step 804, one checks if the counter is equal to N at step 806. If the counter is not equal to N, the preceding steps are repeated from the step 802. When the counter is equal to N at step 807, the jump to track N has been performed.

The method for performing jumps according to the invention can be implemented in an integrated circuit, which is intended to be integrated in an optical disc apparatus such as a CD or a DVD player and/or recorder. A set of instructions that is loaded into a program memory causes the integrated circuit to carry out the method for performing jumps. The set of instructions may be stored on a data carrier such as, for example, a disk. The set of instructions can be read from the data carrier so as to load it into the program memory of the integrated circuit, which will then fulfil its role.

Claims

1. A track jump unit for performing jumps of a light beam (221) of an optical pickup device (201) from a first track to a second track of a disc (211), said unit comprising:

- displacing means (202) for displacing the light beam, said displacing means being controlled by a displacing signal (235);
- reflected light beam detecting means (203) for detecting a light beam reflected from the disc when said disc is supplied with a light beam coming from the optical pickup device, and for producing a reflected light beam signal (231);
- radial error detecting means (204) for producing a radial error signal (232) when said radial error detecting means are supplied with at least one reflected light beam signal, said radial error signal comprising at least a portion corresponding to the first track;
- counting means (205) for associating at least a current track identifier (234) to the first track;
- extended radial error computing means (206) for computing an extended radial error signal when supplied with the radial error signal, said extended radial error signal being a monotonous signal based on at least a portion of the radial error signal and comprising portions having track identifiers associated thereof;
- generating means (207) for generating the displacing signal, said generating means being controlled by the extended radial error signal and a current track identifier, a jump from the first track to the second track being performed by modifying the current track identifier.

2. A method for performing jumps of a light beam of an optical pickup device from a first track to a second track of a disc, said method comprising the steps of:

- detecting a light beam reflected from the disc when said disc is supplied with a light beam coming from the optical pickup device, and producing a reflected light beam signal;
- producing a radial error signal from at least one reflected light beam signal, said radial error signal comprising at least a portion corresponding to the first track;
- associating at least a current track identifier to the first track;
- computing an extended radial error signal when supplied with the radial error signal, said extended radial error signal being a monotonous signal based on at least a portion of the radial error signal and comprising portions having track identifiers associated thereof;

- providing the extended radial error signal and a current track identifier to displacing means for displacing the light beam;
- performing a jump from the first track to the second track by modifying the current track identifier.

3. A method for performing jumps of a light beam of an optical pickup device from a given track to a desired track of a disc, said method being performed by jumping from one track to a directly adjacent track until reaching the desired track, each of these jumps being performed according to the method claimed in claim 2.

4. An optical disc apparatus for reading and/or recording data from and/or to an optical disc, said apparatus comprising a track jump unit as claimed in claim 1.

5. A computer program comprising a set of instructions which, when loaded into a processor or a computer, causes the processor or the computer to carry out the method for performing jumps as claimed in Claim 2.

Abstract

The invention relates to a track jump unit and a method for performing jumps of a light beam (221) of an optical pickup device (201) from a first track to a second track of a disc. The radial error signal is detected, and an extended radial error signal is derived from the radial error signal, this extended radial error signal being a monotonous signal comprising portions having track identifiers associated thereof. Based on the value of the current track identifier and the extended radial error signal, a displacing signal is generated in order to displace the light beam. To perform a jump, the current identifier is modified, so as to displace the light beam to the desired track.

Fig.2

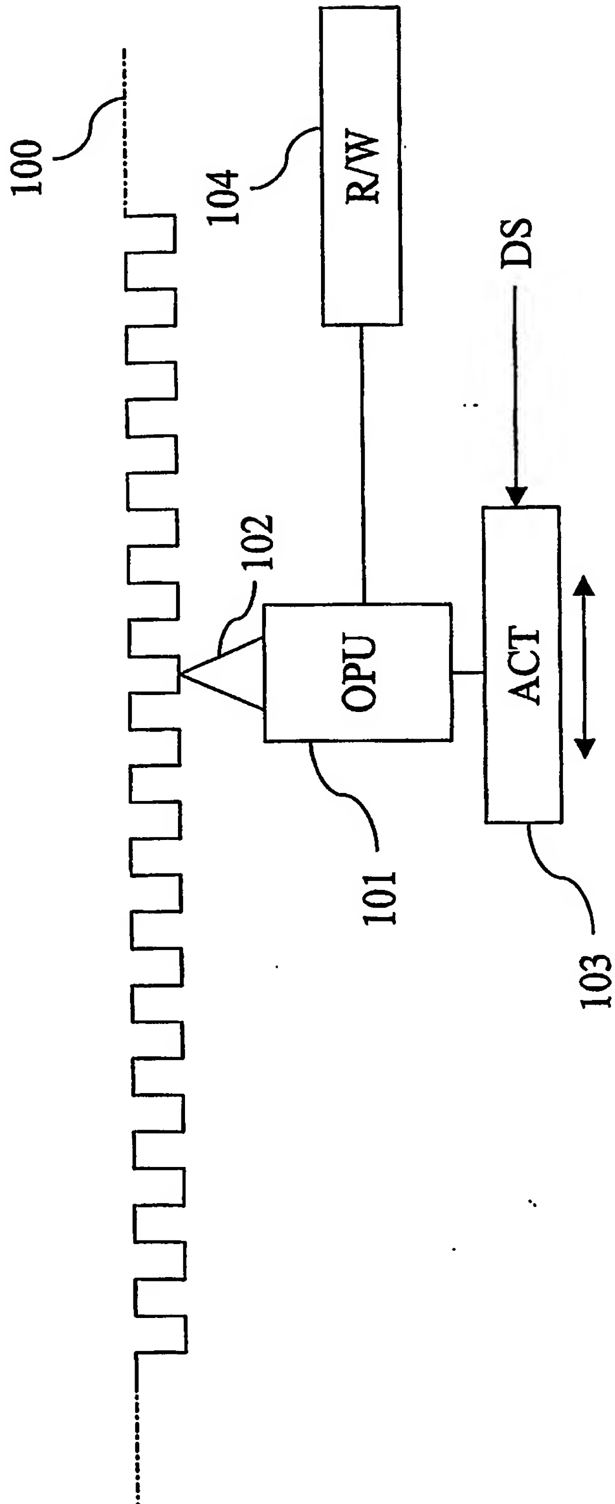


FIG. 1

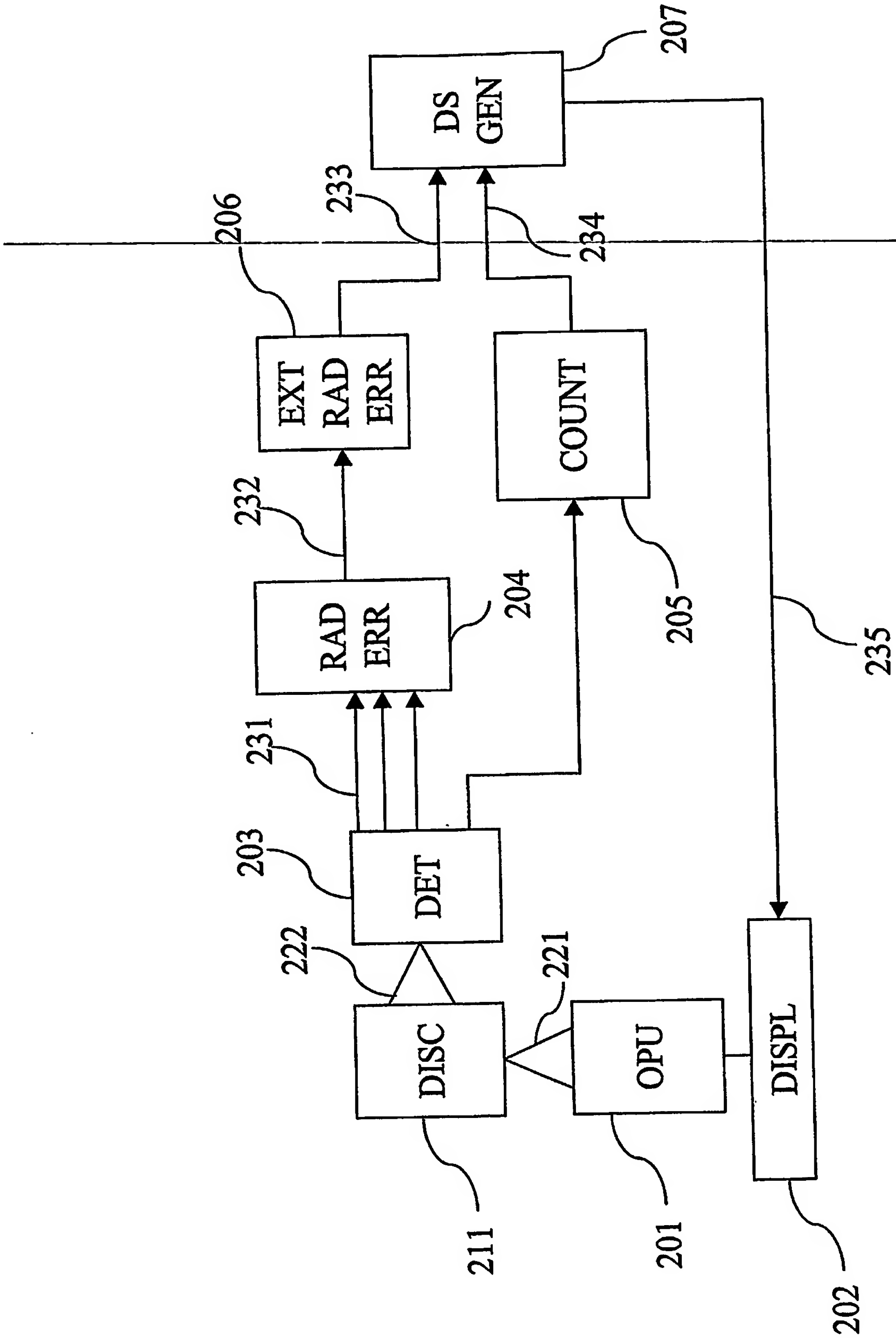

DS GEN
207
206
233
234
EXT RAD ERR
COUNT
232
RAD ERR
204
205
235
231
203
DET
222
221
DISC
OPU
DISPL
211
201
202

FIG. 2

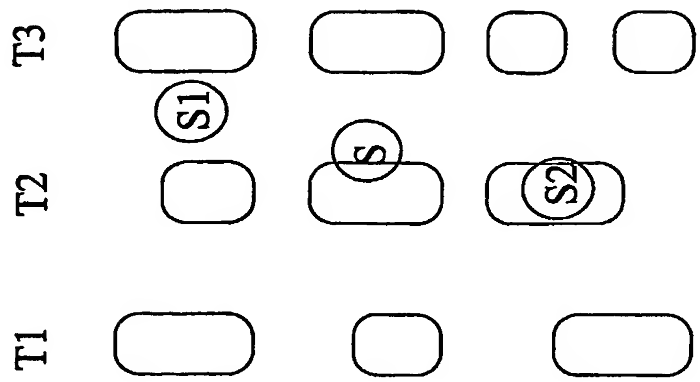


FIG. 3c

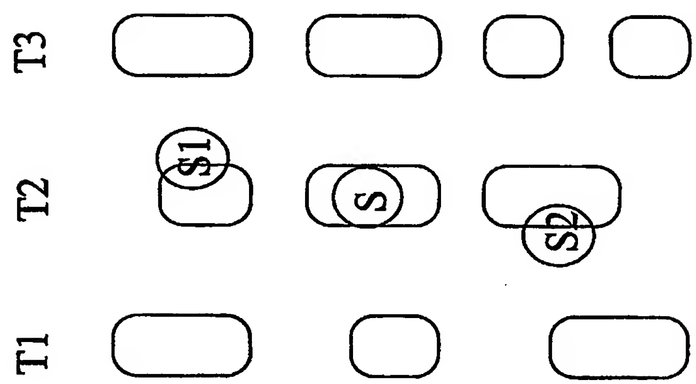


FIG. 3b

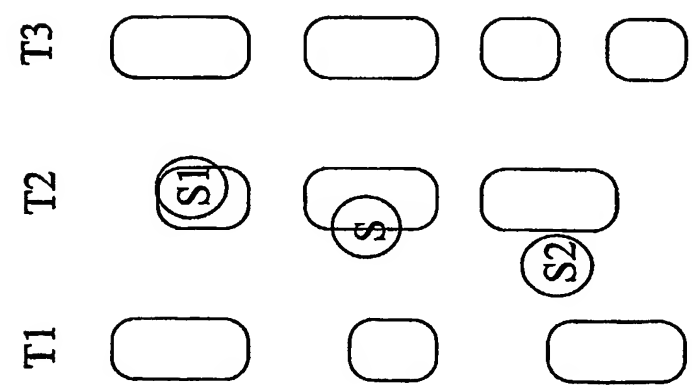
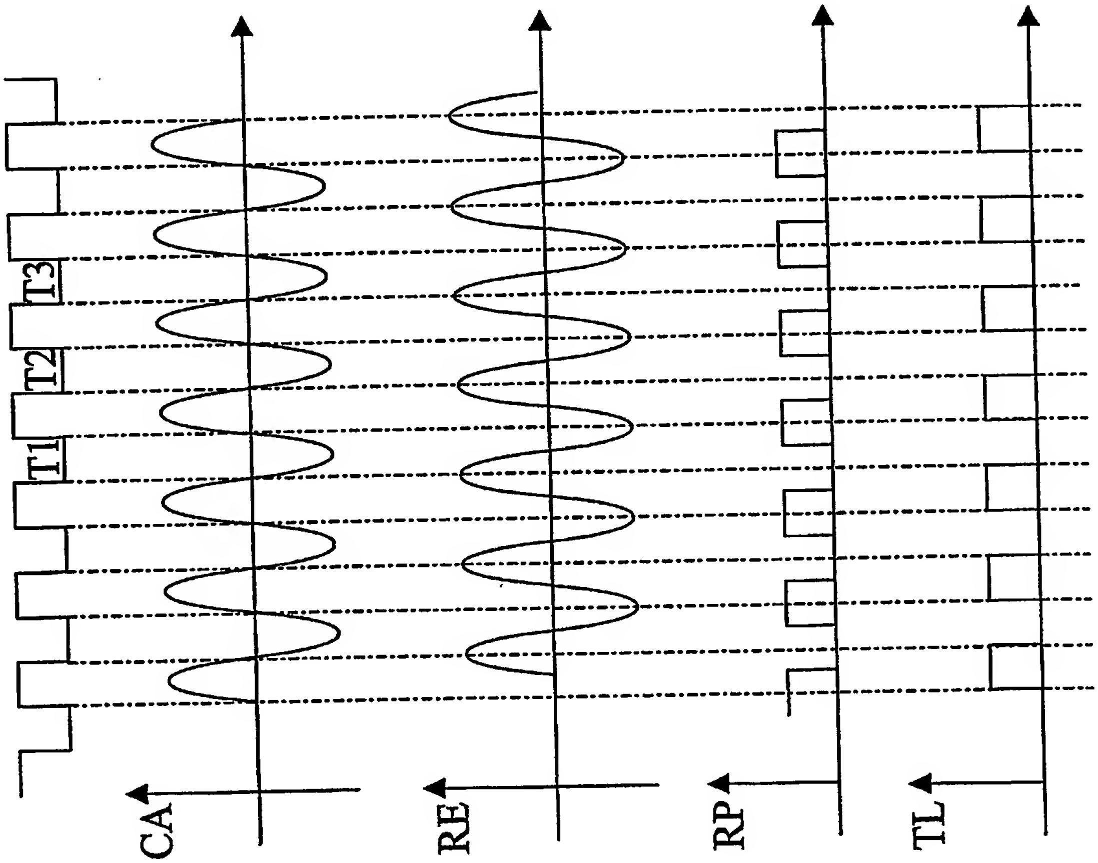


FIG. 3a

FIG. 4



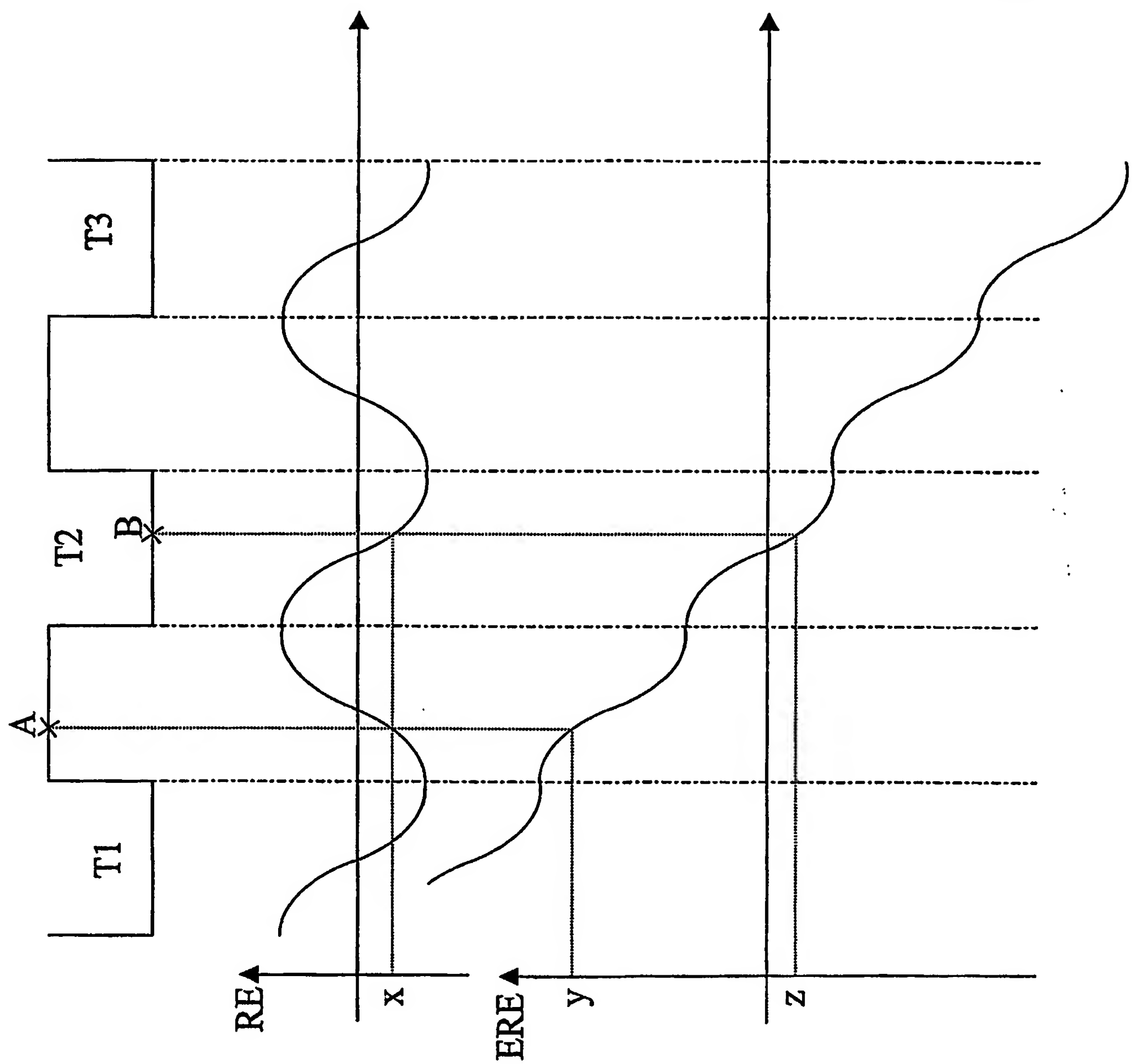
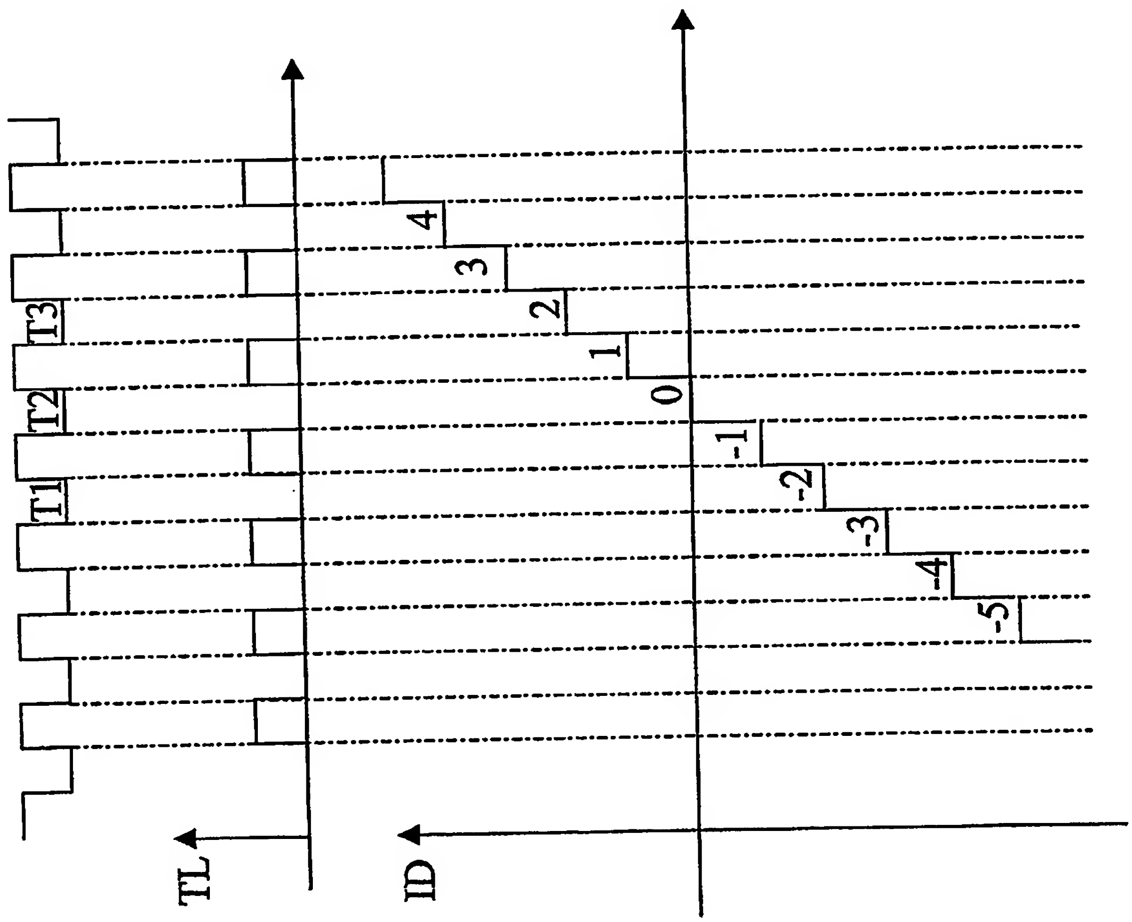


FIG. 5

FIG. 6



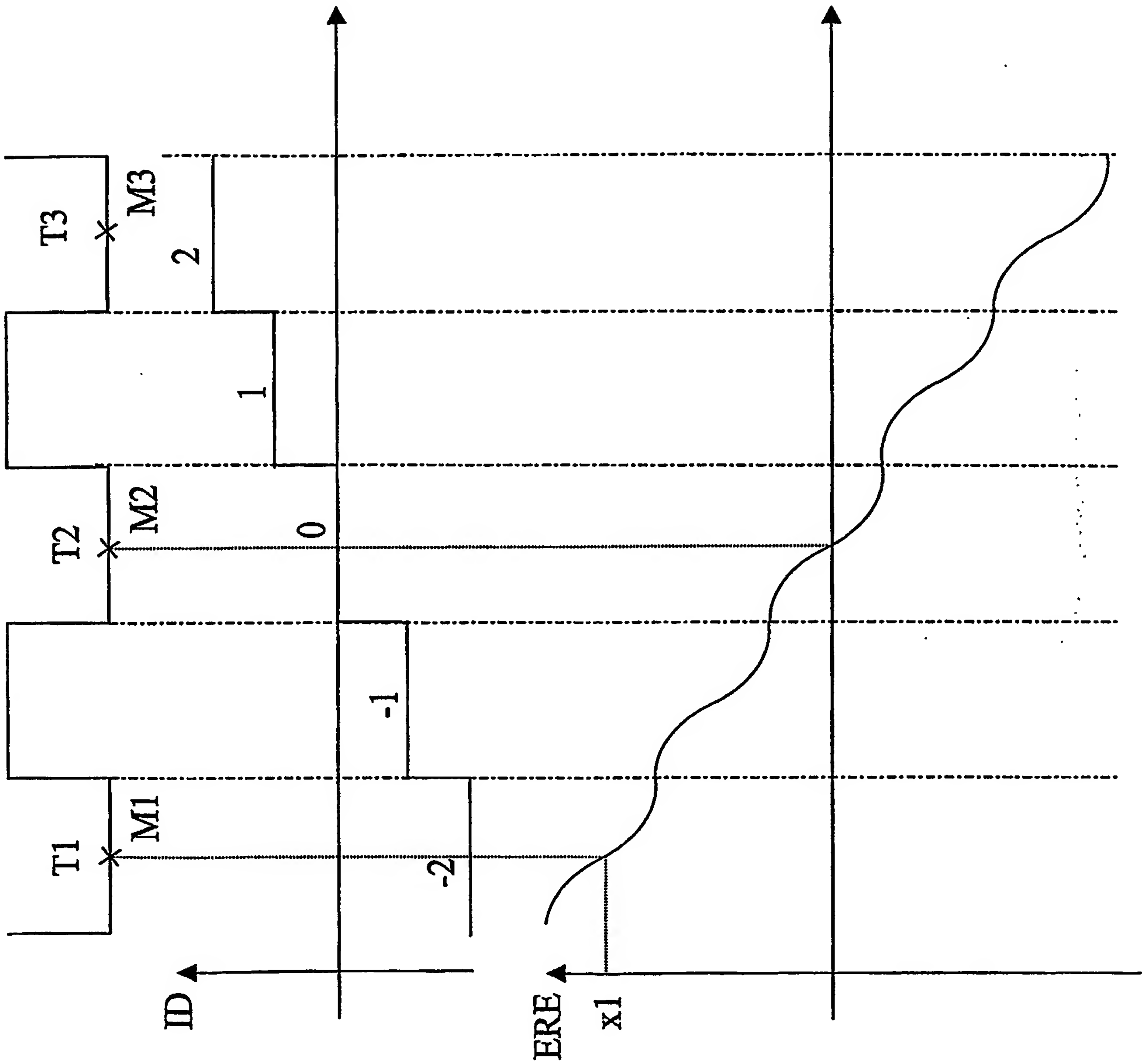


FIG. 7

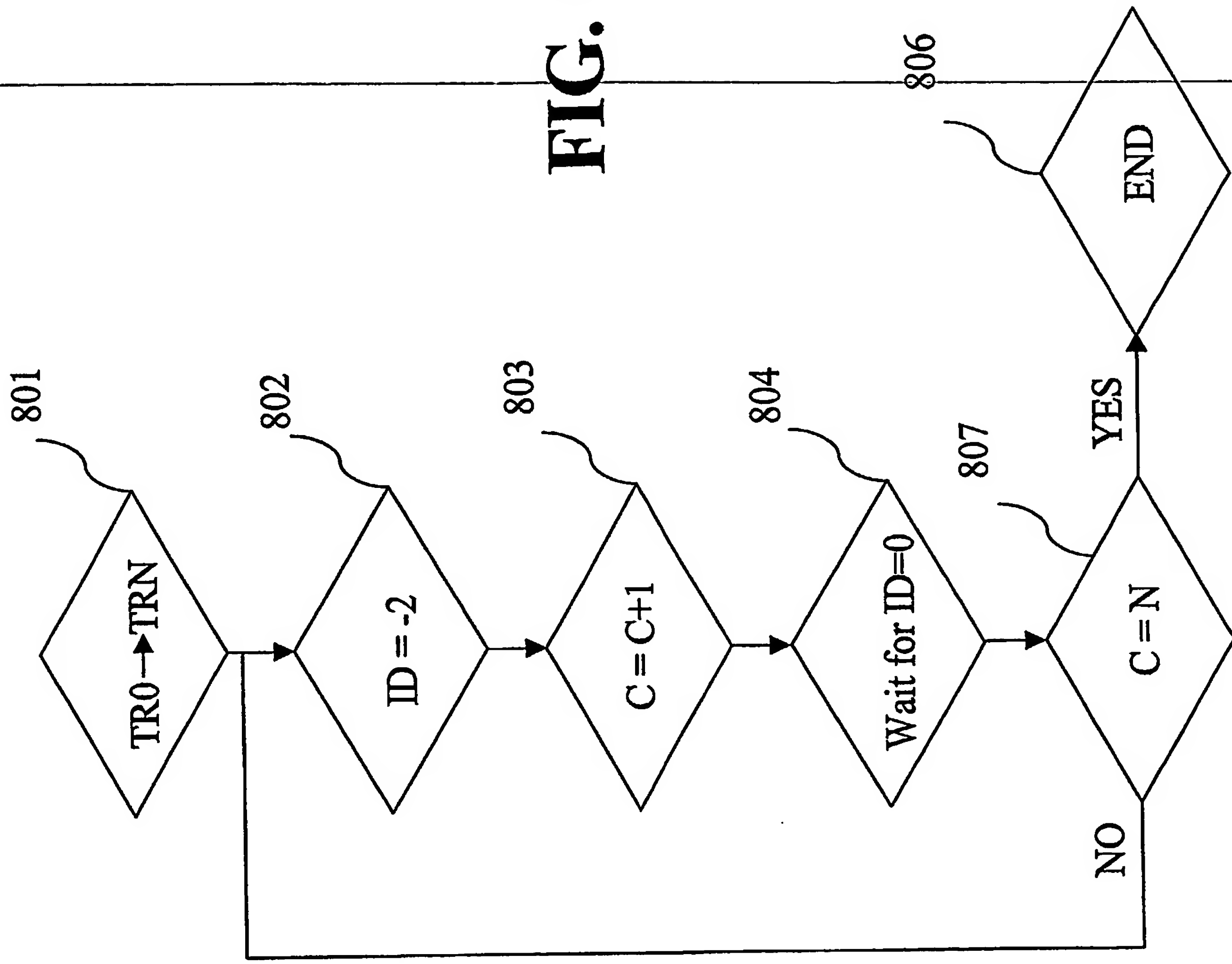

801
TR0→TRN
802
ID = -2
803
C = C+1
804
Wait for ID=0
807
C = N
YES
NO
806
END

FIG. 8

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